COMPARISON OF HEALTH STATUS BETWEEN ORGANIC AND CONVENTIONAL PRODUCTS

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ABSTRACT

This paper reports the results of two trials carried out to estimate the hygienic-sanitary status of samples obtained from organic farming in comparison with products obtained from conventional agriculture. In three years of activity were carried out analyses on samples of common or durum wheat and on processing products like flour, bran, macaroni and bread obtained from biological and conventional method. Also samples of vegetables and fruits were analyzed. The laboratory analyses have been focalized on qualitative and quantitative evaluation of fungal contamination and surveying of pesticide residues level. The great size of collected data has not highlighted substantial differences between the two analyzed typologies. About pesticide residues levels, generally they proved to be contained under the Italian legal limit, so both these products can be considered healthy under a hygienic-sanitary profile. The trials should be extended also to other cultivations like herbs, fruit trees and vegetables to improve our knowledge's about qualitative and hygienic differences beyond the two methods of production and defense.

INTRODUCTION

In the last times, also because of the recent and important cases of human pathologies tied up to the feeding, one increased sensibility is recorded toward the quality of the foods and the great request of fruits and vegetables gotten with the organic method of production. As it is well known, the products destined to the human feedings can represent a favourable substratum to the instauration of pathogens and from the metabolism of some fungal strains can derive the formation of mycotoxins'. Therefore we investigated, in a triennium of activity on the level of fungal contamination and the level of pesticide residues present on some products, sampled at harvest time, coming from organic cultivations in comparison to products gotten by conventional farms to verify if to agronomic techniques could correspond a presence quantitatively and qualitatively diversified of mycopathogens on the products and a different presence of residues too. Analyses have been conducted on grains of common and durum wheat and their processing products and on various species of fruits.

MATERIALS AND METHODS

Cereals

In the triennium of activity analyses has been conducted on different types of samples.
During the 1st year, seed of common and durum wheat coming from farms both biological and conventional and on some processing products (flour, bread, bran and macaroni) has been analyzed. In the 2nd year of activity

analyses have been performed on different samples of seeds of common and durum wheat. During the 3rd year of activity analyses have been conducted on samples of seeds of common wheat.
The laboratory analyses have been focused on qualitative and quantitative evaluation of fungal contamination by means of:

Inspection of dry seeds

The dry seeds were examined for impurities, classified partly as "inert matter", such as plant debris, sclerotia, galls, insects etc., also for symptoms such as discoloration, malforming and similar indications of infection, including fruiting bodies of fungi, resting hyphae on the surface of the seed, spore or bacterial masses on the seeds.

Examination of suspensions obtained from washing of seeds

Two samples of 25 seeds were shaken for 10 minutes in 10 ml of water.
The suspension obtained was concentred by centrifuging (15 min at 2.500 RPM).
The concentrate remainder was diluted in 2 ml of water and examined under the microscope using a haemocytometer and has been counted the number of spores (n) for gram of seeds applying the following formula:

$$n = \frac{N \times V}{0.001 \times P}$$

Where N is the number of spores for square delimited by the triple line, V is the volume in which it is suspended the sediment (2 ml), P is the weight of the seeds in g, and 0.0001 is the volume of the liquid in the central square.

Blotter test method

Ten seeds were sown in petri dishes on moistened absorbent paper. The seeds were incubated for 7 days at 20 °C under near ultraviolet radiation. Recording was made by a low power stereo-microscope. The test was made, at the same time, by killing seed's embryos. The seeds were incubated in the dark for 24 h, then conserved in freezer for 24 h and again incubated for 6 days under near ultraviolet radiation.

Agar plate test-examination of colonies developed from seeds plated on agar media

The seeds, pre-treated with sodium hypochlorite to prevent profuse development of saprophytes, were plated in Petri dishes containing Malt Extract Agar or PDA added whit streptomycin sulphate (100 µg/ml). Seeds were incubated for 7 days at 20 °C. Classification and colony counting was made under a low power sterol-microscope and microscope.

Isolation of single fungal colony forming units (c.f.u.).

It has been preliminarily determined the weight of grain through drying in stew. Then, 100 g of grains was poured in a solution (8.5 g of NaCl + 1 g of Bacto-peptone + 0.33 g of Tween 80 + diluted to 1000 ml with ph 7 distilled water to revitalize micro organisms for 20 minutes and then crushed.
The seeds have been shattered and, from the gotten suspension, prepared 2 subsequent dilutions that have been arranged in Petri dishes containing 20 ml of 2% malt extract agar added with 0.01% of chloramphenicol. 2 repetitions have been prepared for each dilution. The plates have been, therefore, incubated at 20°C for 7 days and at the end of the period of incubation have been proceeded to the calculation of the number of colonies and their identification. The results have been express in number of colonies per gram of dry weight of wheat (C.F.U./g). As regard to the transformed ones, the microbiological analyses of the flour and the bran has consisted in the calculation of the number of colonies developed in Petri plates. A sub sample was added in the medium (Malt Salt Agar) before the solidification, opportunely diluted in a 0.5% solution of NaCl. The quantity of the inoculum has been expressed in C.F.U./g. To determine pesticides, official method (ISTISAN 97/23) "Multiresidue Methods for pesticides analysis in vegetables products" were used. The total copper was determined by means of spectrophotometry in atomic absorption by acetylene-air flame (FAAS at λ = 324.8) after mineralization with microwave CEM oven (Microwave Digestion System 205). The sampling, in numbers of four, was carried out for every replicate of every thesys.

Fruits and vegetables

The analyses on samples of fruits and vegetables have been carried out throughout the triennium.
During the 1st year of activity, microbiological analyses have been effectuated on samples of tomatoes and apples coming from farms both biological and conventional. In the 2nd and 3rd year of activity the analyses has been performed on samples of oranges and peaches, plums and pears coming from farms both biological and conventional. For the microbiological analyses the same method of dilution and counting of colonies (C.F.U.) has been performed.
After 5 days of incubation, in thermostat at 20° C, has been effected the counting of the C.F.U. per g) according to the following formula:

$$\frac{\Sigma C}{(n_1 + 0.1 \times n_2) \times f}$$

where C is the sum of the colonies counted on all the Petri plates, n_1 it is the number of plates at the lowest dilution, n_2 is the number of plates to the following dilution, f is dilutions factor of the dilution lowest expressed at the negative power of 10. We have proceeded to the identification of the mycetes on the base of the morphological, biometric and cultural characteristics of the isolated ones. Besides, on the fruits and vegetables, in 2nd and 3rd year of activity, chemical analyses has also been conducted to investigate on the presence of the residues of the chemical treatments effectuated in field, ac-

cording to the following method: for the determination of the dithiocarbamates, the Official Method of Analysis has been used (D. Ministry of Health, 1981) that consists in the analytical determination of the carbondisulfide that develops, under certain conditions, from thiuramdisolfures and dithiocarbamates. To determine of the other active ingredients distributed on the plants during the whole vegetative cycle (phosphorates, imidacloprid, sulphur) the methods rediged by the Superior Institute of Health (I.S.S., 1997) "Multi-residue Methods for the Analysis of residues of pesticides in vegetable products" have been used. It can be so synthesized:
- extraction with acetone, repartition with dichloromethane in separator funnel; clean up on silica-gel cartridge. After adequate dilutions, the extract has been analyzed using a gas chromatograph HRGC of CarloErba. Instrumentations now Thermo electron equipped with an electron capture detector (ECD), or a nitrogen-phosphorus selective detector (NPD). For the survey of the roterione a liquid chromatograph HPLC has been used. Copper measurement has been made by means of spectrophotometry in atomic absorption (AAS) by acetylene-air flame (FAAS at λ=324.8) after mineralization in microwave CEM oven (Microwave Digestion System 205). Have been sampled and analyzed 4 repetitions for each thesys.

RESULTS

Cereals

The data related to the 1st year are resumed in the Tables 1 and 2. We considered opportune not to bring all the tables related to the 1st year of activity but only the most meaningful. No substantial differences have emerged from the comparisons of the two theses, in fact, in general, the same mycofungal pathogens have been in relief both on the samples biological and conventional and whereas the mycetes are only present in one of the two typologies of farm management, their frequency results extremely contained.

Table 1. Results of mycological analyses in humid rooms on common wheat seeds during the first year of activity

CULTIVAR	PRODUCTION METHOD	*Alternaria* sp.	*Aspergillus* sp.	*Cephalosporium* sp.	*Cladosporium* sp.	*Epicoccum* sp.	*Fusarium poae*	*Humicola* sp.	*Penicillium* sp.	*Stachybotrys* sp.	*Stemphylium* sp.	Yeasts
Centauro	Conventional	*	*	*	*				*	*	*	
	Biological	**		*	**	*	*	*	*		*	*

* = up to 30% of infected seeds; **= from 31 to 70% of infected seeds; ***= from 71 to 100% of infected seeds.

Table 2. Results of mycological analyses in humid rooms on hard wheat seeds during the first year of activity

CULTIVAR	PRODUCTION METHOD	*Alternaria* sp.	*Cephalosporium* sp.	*Cladosporium* sp.	*Epicoccum* sp.	*Fusarium equiseti*	*Fusarium poae*	*Geotrichum* sp.	*Gonatobotrys* sp.	*Humicola* sp.	*Penicillium* sp.	*Stachybotris* sp.	*Stemphylium* sp.	*Ulocladium* sp.	Yeasts
Grazia + Creso	Conventional	***	*	**			*	*	*		*		*		
	Biological	***	*	**	*	*				*	*	*	*	*	*

* = up to 30% of infected seeds; **= from 31 to 70% of infected seeds; ***= from 71 to 100% of infected seeds.

The inoculum present on flour, bread, bran and macaroni gotten by grains cultivated according to the biological method of cultivation has not been different from that coming from grains obtained with the traditional method.
As regards the durum wheat, the results of the mycological analyses are reported in Table 2. Also in this case the biological seeds have not underlined a different degree of fungal contamination in comparison to that conventional. In fact, even if, in the various effectuated test, they have been founded, sometime, different fungal pathogens on the two typologies of samples, such differences result extremely contained.
As regards the 2nd year of activity, the data are brought in the Table 3. The data do not highlight substantial differences between the two methods of production.
As regards the 3rd year of activity, the data are brought in the Table 4, in which the values are brought related to the C.F.U./g. Only for the variety Enesco has statistically been found in relief meaningful differences among the conventional and biological theses with a great level of fungal contamination present on grains coming from the biological method of production.

Table 3. Number of colonies for g of dried weight (C.F.U./g) and identified fungal pathogens during the second year of activity

CULTIVAR	PRODUCTION METHOD	C.F.U./g	IDENTIFIED FUNGAL PATHOGENS
Arnal	Conventional	2.1x10^{4} abcd	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Fusarium poae*, *Nigrospora* spp., *Penicillium* spp., *Ulocladium* spp., yeasts
	Biological	2.0x10^{4} abc	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Penicillium* spp., *Rhizopus* spp., yeasts
Colfiorito	Conventional	1.9x10^{4} abc	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Helminthosporium* spp., *Penicillium* spp., yeasts
	Biological	2.1x10^{4} abcd	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., yeasts
Enesco	Conventional	2.8x10^{4} de	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Fusarium poae*, *Rhizopus* spp., *Ulocladium* spp., yeasts
	Biological	2.1x10^{4} abcde	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Stemphylium* spp.,
Etecho	Conventional	2.3x10^{4} bcde	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Helminthosporium* spp., yeasts
	Biological	2.1x10^{4} abcd	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Penicillium* spp., yeasts
Eureka	Conventional	2.9x10^{4} e	*Alternaria* spp , *Cladosporium* spp., *Epicoccum* spp.
	Biological	2.6x10^{4} cde	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., yeasts, *Rhizopus* spp.
Guadalupe	Conventional	2.3x10^{4} bcde	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., yeasts
	Biological	1.6x10^{4} ab	*Alternaria* spp , *Cladosporium* spp., *Epicoccum* spp., yeasts
Miel	Conventional	1.7x10^{4} ab	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Stemphylium* spp., *Ulocladium* spp., yeasts
	Biological	1.3x10^{4} a	*Alternaria* spp., *Aspergillus* spp., *Cladosporium* spp., *Epicoccum* spp., *Fusarium chlamydosporum*, yeasts
Sagittario	Conventional	2.0x10^{4} abc	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Fusarium poae*, *Penicillium* spp., *Ulocladium* spp., yeasts,
	Biological	1.9x10^{4} abc	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Penicillium* spp. , yeasts
Serio	Conventional	2.3x10^{4} bcde	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Fusarium poae*, *Rhizopus* spp., yeasts
	Biological	1.8x10^{4} ab	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., yeasts
Soissons	Conventional	2.1x10^{4} abcd	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Helminthosporium* spp., yeasts
	Biological	1.4x10^{4} a	*Alternaria* spp., *Cladosporium* spp., *Epicoccum* spp., *Fusarium poae*, yeasts

Values followed by the same letters do not differ significantly according to Duncan's multiple range test for P=0.05.

Table 4. Number of colonies for g of dried weight (C.F.U./g) and identified fungal pathogens during the third year of activity

CULTIVAR	PRODUCTION METHOD	C.F.U./g	IDENTIFIED FUNGAL PATHOGENS
6041-w21	Conventional	1.8x10^{4} abcd	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Alternaria* spp., *Rhizopus* spp., *Diplococcium* spp., *Epicoccum* spp., *Fusarium oxisporum*
	Biological	1.2x10^{4} ab	*Cladosporium* spp., yeasts, *Rhizopus* spp., *Epicoccum* spp., *Ulocladium* spp., *Alternaria* spp., *Sclerotinia* spp., *Diplococcium* spp.
Colfiorito	Conventional	2.4x10^{4} abcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp., *Alternaria* spp.
	Biological	1.6x10^{4} abcd	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp., *Alternaria* spp., *Penicillium* spp.
Craklin	Conventional	2.1x10^{4} abcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Alternaria* spp., *Epicoccum* spp., *Rhizopus* spp., *Penicillium* sp., *Diplococcium* spp.
	Biological	2.2x10^{4} abcde	*Cladosporium* spp., yeasts, *Rhizopus* spp., *Ulocladium* spp., *Penicillium* sp., *Rhyzoctonia* spp., *Sclerotinia* spp.
Enesco	Conventional	2.6x10^{4} abcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp., *Diplococcium* spp., *Alternaria* spp., *Sclerotinia* spp.
	Biological	4.9x10^{4} f	*Cladosporium* spp., yeasts, *Rhizopus* spp., *Ulocladium* spp., *Penicillium* sp.
Etecho	Conventional	1.3x10^{4} abc	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Alternaria* spp., *Epicoccum* spp., *Rhizopus* spp., *Rhyzoctonia* spp., *Stemphylium* spp.
	Biological	8.4x10^{3} a	*Cladosporium* spp., yeasts, *Epicoccum* spp., *Ulocladium* spp., *Alternaria* spp., *Stemphylium* spp.
Eureka	Conventional	2.8x10^{4} bcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp.
	Biological	2.4x10^{4} abcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Epicoccum* spp., *Penicillium* sp., *Alternaria* spp.
Guadalupe	Conventional	2.1x10^{4} abcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp., *Alternaria* spp.
	Biological	1.5x10^{4} abcd	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Penicillium* sp.
Las1006	Conventional	1.4x10^{4} abc	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp., *Alternaria* spp., *Rhyzoctonia* spp.
	Biological	1.0x10^{4} ab	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp.
Sagittario	Conventional	2.0x10^{4} abcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Alternaria* spp., *Epicoccum* spp., *Penicillium* sp., *Botrytis* sp.
	Biological	1.7x10^{4} abcd	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Alternaria* spp., *Epicoccum* spp., *Septoria* sp., *Rhizopus* spp., *Diplococcium* spp., *Fusarium equiseti*
Sal 144	Conventional	1.8x10^{4} abcd	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Epicoccum* spp., *Rhizopus* spp., *Alternaria* spp., *Botrytis* spp.
	Biological	1.7x10^{4} abcd	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Alternaria* spp., *Rhyzoctonia* spp., *Epicoccum* spp.
Saliente	Conventional	1.3x10^{4} abc	*Cladosporium* spp., yeasts, *Rhizopus* spp., *Ulocladium* spp., *Alternaria* spp., *Epicoccum* spp.
	Biological	1.7x10^{4} abcd	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Penicillium* spp., *Epicoccum* spp., *Botrytis* sp., *Stemphylium* spp.
Serio	Conventional	1.8x10^{4} abcd	*Cladosporium* spp., yeasts, *Rhizopus* spp., *Ulocladium* spp., *Epicoccum* spp., *Alternaria* spp., *Stemphylium* spp.
	Biological	2.0x10^{4} abcde	*Cladosporium* spp., yeasts, *Epicoccum* spp., *Ulocladium* spp., *Rhizopus* spp., *Alternaria* spp.

CULTIVAR	PRODUCTION METHOD	C.F.U./g	IDENTIFIED FUNGAL PATHOGENS
Sk 26	Conventional	3.2x10⁴ de	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Diplococcium* spp., *Rhizopus* spp., *Epicoccum* spp., *Alternaria* spp., *Penicillium* sp.
	Biological	3.0x10⁴ cde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Alternaria* spp., *Penicillium* sp., *Rhizopus* spp., *Epicoccum* spp., *Sclerotinia* spp.
Soissons	Conventional	1.2x10⁴ ab	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Alternaria* spp., *Epicoccum* spp., *Rhizopus* spp., *Penicillium* sp., *Torula* sp.
	Biological	1.1x10⁴ ab	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Epicoccum* spp., *Penicillium* sp., *Alternaria* spp., *Rhyzoctonia* spp.
Tibet	Conventional	3.7x10⁴ et	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Rhizopus* spp., *Epicoccum* spp., *Penicillium* sp., *Alternaria* spp.
	Biological	2.7x10⁴ bcde	*Cladosporium* spp., yeasts, *Ulocladium* spp., *Epicoccum* spp., *Rhyzoctonia* spp., *Penicillium* sp., *Alternaria* spp., *Fusarium moniliformis*

Values followed by the same letters do not differ significantly according to Duncan's multiple range test for P = 0.05.

Fruits and vegetables

As regards the 1st year of activity, the analyses effectuated on tomatoes and on apples, have not statistically underlined meaningful differences among the two typologies of samples.

Table 5. Number of colonies for gram of product (C.F.U./g) and identified fungal pathogens during the second year of activity

SPECIES AND CULTIVAR	PRODUCTION METHOD	C.F.U./g	IDENTIFIED FUNGAL PATHOGENS
ORANGES cv. VALENCIA	Conventional	1.4 x 10⁴ a	*Cladosporium herbarum, Gliocladium* sp., *Epicoccum* sp., *Mucor* sp., *Fusarium* sp.
	Biological	1.1 x 10⁴ a	*Cladosporium herbarum, Fusarium* sp., *Alternaria Alternata, Mucor* sp., *Gliocladium* sp.
PEACHES cv. SPRING LADY	Conventional	1.5 x 10⁴ a	*Cladosporium herbarum, Penicillium* sp., *Alternaria alternata, Epicoccum* sp., *Mucor* sp.
	Biological	1.6 x 10⁴ a	*Cladosporium herbarum, Epicoccum* sp. , *Alternaria alternata, Penicillium* sp, *Gliocladium* sp.
PLUMS cv. SHIRO	Conventional	2.1 x 10⁴ a	yeasts, *Mucor* sp., *Cladosporium* sp., *Fusarium* sp., *Penicillium* sp.
	Biological	3.2 x 10⁴ a	yeasts, *Mucor* sp., *Cladosporium* sp., *Epicoccum* sp., *Penicillium* sp, *Fusarium* sp., *Alternaria* sp.
PEARS cv. WILLIAM	Conventional	1.8 x 10⁴ a	*Cladosporium* sp., *Gloeosporium* sp., *Alternaria* sp., *Fusarium* sp.
	Biological	2 x 10⁴ a	*Cladosporium* sp., *Gloeosporium* sp., *Epicoccum* sp., *Alternaria* sp., *Fusarium* sp.

Values followed by the same letters do not differ significantly according to Duncan's multiple range test for P = 0.05.
The pathogens have been inserted in decreasing order, according to their numerical presence in the plates.

The results related to 2nd and a 3rd year of activity are respectively resumed in the Table 5 and 6. The Table 5, that refers to the mycological analyses conducted on oranges, peaches, plums and pears, haven't statistically underlined meaningful differences among the biological and conventional samples, neither substantial differences relatively to the identified mycetes.

The examination of the Table 6, related to the calculation of the vital unities presents on the samples of oranges, peaches (cv. Spring Lady), plums and pears analyzed in the 3rd year, don't statistically showed meaningful differences among the conventional and biological theses; appreciable qualitative differences don't emerge in relationship to the fungal pathogens identified. The mycological analyses carried out on peaches of the cv. Regina Bianca, have statistically underlined instead meaningful differences among the conventional and biological thesis with a level of fungal contamination more elevated on the samples, coming from conventional agriculture; the identified mycetes are resulted, in wide measure, the same ones, even if some differences of qualitative order have also been among the two typologies of compared samples.

As regards the chemical analyses carried out in the second year, we found no phytosanitary products residues on the all oranges, which are broadly justified by the examination of the technical sheets furnished by the technicians of the farms. Results, in fact, that all the oranges have been submitted only to treatment with white oil. The residues of dithiocarbamates found on the peaches and on the plums and those of dimethoate found on the pears conventionally treated, are resulted well below the Italian legal limits and therefore the products must be judged healthy under a hygienic-sanitary (Table 7) point of view.

Table 6. Number of colonies for gram of product (C.F.U./g) and identified fungal pathogens during the third year of activity

SPECIES AND CULTIVAR	PRODUCTION METHOD	C.F.U./g	IDENTIFIED FUNGAL PATHOGENS
ORANGES cv. VALENCIA	Conventional	1.4 x 10⁴ a	*Cladosporium* spp., *Penicillium canescens, Penicillium janthinellum, Penicillium italicum, Penicillium oxalicum,* yeasts, *Epicoccum* sp., *Fusarium* sp.
	Biological	4.7 x 10⁴ a	*Cladosporium* spp., yeasts, *Rhizopus* sp., *Rhizoctonia* sp., *Ulocladium* spp., *Penicillium italicum, Penicillium claviforme*
PEACHES cv. SPRING LADY	Conventional	3.3 x 10⁴ a	*Cladosporium spp.*, yeasts, *Rhizopus* spp, *Ulocladium* sp., *Penicillium chrysogenum, Fusarium* sp., *Gonatobotrys* sp., *Aspergillus* sp.
	Biological	1.6 x 10⁴ a	yeasts, *Cladosporium* spp., *Rhizopus* spp., *Penicillium chrysogenum, Penicillium janthinellum, Penicillium commune, Penicillium brevi-compactum, Gonatobotrys* sp., *Alternaria* sp., *Ulocladium* sp.
PEACHES cv. REGINA BIANCA	Conventional	9.3 x 10⁴ b	yeasts, *Cladosporium* spp., *Alternaria* spp., *Penicillium brevi-compactum, Penicillium citrinum, Epicoccum* sp., *Rhizoctonia* sp., *Stemphylium* sp., *Aspergillus niger, Penicillium notatum.*
	Biological	1.9 x 10⁵ a	yeasts, *Cladosporium* spp., *Penicillium citrinum, Penicillium brevi-compactum, Penicillium lilacinum, Rhizoctonia* spp., *Fusarium* spp., *Rhizopus* spp., *Torula* spp., *Ulocladium* sp., *Penicillium notatum.*

PLUMS cv. SHIRO	Conventional	15.4 x 10^2 a	yeasts, *Penicillium nigricans, Penicillium brevi-compactum, Penicillium janthinellum, Penicillium expansum, Penicillium chrysogenum, Penicillium cyclopium, Rhizopus* sp., *Cladosporium* spp., *Oidiodendron* sp.
	Biological	2.6 x 10^2 a	yeasts, *Cladosporium* spp., *Penicillium expansum, Penicillium ochraceum, Penicillium brevi-compactum, Penicillium claviforme, Penicillium simplicissimum, Rhizopus* sp., *Alternaria* spp., *Aspergillus* spp., *Epicoccum* spp.
PEARS cv. WILLIAM	Conventional	1.0 x 10^3 a	yeasts, *Cladosporium* spp., *Phytophthora cactorum, Rhizopus nigricans, Alternaria* spp., *Fusarium* spp., *Penicillium corylophilum*
	Biological	1.7 x 10^3 a	yeasts, *Cladosporium* spp., *Penicillium expansum, Penicillium corylophilum, Penicillium funiculosum, Penicillium janthinellum, Penicillium chrysogenum, Penicillium nigricans, Fusarium* spp., *Rhizopus nigricans, Alternaria* spp., *Stemphylium* sp., *Geotrichum* sp.

Values followed by the same letters do not differ significantly according to Duncan's multiple range test for P = 0.05.
The pathogens have been inserted in decreasing order, according to their numerical presence in the plates.

The results of the chemical analyses performed during the 3rd year are listed in the Table 8 that reports, if the result of the search results negative, the limits of sensibility of the used analytical methods. Among the products of synthesis have been recovered (only on peaches coming from the conventional management farms) the Dimethoate (0.024 mg/kg) that today (Ministry Decree of July 22nd 2003, G.U. n° 232 of October 6th 2003) it is not more authorized for the use in field on peaches (there is a tolerance of 0.02 mg/kg on imported commodities, for comunitary recepments).

Table 7. Values of pesticide residue levels found on fruits during the second year of activity

Species	Active Ingredients	Residues (mg / kg)	Italian MRL at the moment of analyses
PEACHES	Dithiocarbamates (expressed as CS2)	0.50	2
PEARS	Dimethoate	0.25	1 (*)
PLUMS	Dithiocarbamates (expressed as CS2)	0.64	1
ORANGES cv. TAROCCO GALLO	—	—	—
ORANGES cv. VALENCIA	—	—	—

(*) Actually the Italian MRL for dimethoate is 0.02 mg/kg as sum of dimethoate and omethoate.

Table 8. Pesticide residue levels expressed in mg/kg on pear (cv. William), plums (cv. Shiro) and peach (cv. Regina Bianca) during the third year of activity. Average of 4 repetitions

PESTICIDE	PEARS		PLUMS		PEACHES	
	Conv.	Org.	Conv.	Org..	Conv.	Org..
COPPER	0.8	1.4	0.5	1.1	0.9	1.3
SULPHUR	< 0.01	< 0.01	< 0.01	< 0.01	0.045	< 0.01
DIMETHOATE (organophosphorus)	< 0.002	< 0.002	< 0.002	< 0.002	0.024	< 0.002
IMIDACLOPRID	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
ROTENONE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Comparing the results of the copper found on plums, peaches and pears a greater quantity has constantly been noticed on the samples of the biological crops, almost the double, even if the levels of these residues are always notably inferior to the established MRL that is equal to 20 mg/kg.

DISCUSSION

From the big quantity of picked data during the tree year of activity and relatively to the cereals, the following considerations can be drawn:

- a substantial difference doesn't exist, in terms of fungal contamination, among the analyzed products coming from the biological method of production in comparison to the products gotten by conventional cultivations.
- no difference has been underlined regarding the species of toxinogens fungi in the two typologies of samples. The species of *Fusarium* and *Aspergillus* identified with great frequency have been isolated so much on the samples of biological origin that on the conventional samples.

How much emerged by the investigations can find explanation in the fact that, in the triennium of activity, have been analyzed samples of wheat on which, both in the biological farms and in conventional ones, no fungicide treatments have been applied nor the tanning of the seeds; the unique difference has consisted in the type of manuring and in the general agronomic practices that differentiate the two methodologies of production.
This type of crop doesn't generally, asks for fungicide treatments if not in particular years, which also justifies the great quantity of cultivated wheat surface, converted to the organic method of production.
Also for the samples of fruits no substantial difference has been underlined, in terms of fungal contamination, among the products gotten with the biological method of production in comparison to the conventionally cultivated products.
In the organic farms have been effected organic manurings and treatments with the suitable products in the annex II B of Council Regulation (EEC) n. 2092/91. In the conventional farms, mineral fertilizers have been used and synthetic phytosanitary products. As it regards the cultivation of the oranges, during the 2nd year of activity, mineral fertilizers have been employed in the conventional farm and organic fertilizers in the biological farms. Phytosanitary treatments have not been effectuated in the two agricultural

farms to comparison. For peaches, pears and plums, during the 2nd year of activity, the fields in comparison, to biological and conventional management, equal for variety, sixth of plant and form of breeding are different results in the agronomic management in how much the conventional field has been defended with products of synthesis and manured with mineral fertilizers while the biological field has been treated with products admitted by the biological method of production and exclusively manured with organic products.

During the 3rd year of activity, on the oranges object of investigation, phytosanitary treatments have not been performed in none of the two farms in comparison while a mineral manuring has been effected in the conventionally managed farm and an organic manuring with agrozootechnique compost in the biological farm. For how much it concerns the peaches, pears and plums, for the 3rd year of activity, the two typologies of fields in comparison, have been manured in different way employing mineral fertilizers in the conventionally conducted field and organic fertilizers in the field in biological management. For phytosanitary control has been employed copper salts as antifungal in both the fields in comparison while the insecticide treatments have been carried out with the employment of insecticides of synthesis (imidacloprid and dimethoate) in the field conventionally conducted and the employment of pyrethrum, derris, potassium soap and *Bacillus thuringiensis* in the field conducted according to the organic method.

Relatively to the chemical contamination, the products object of investigation have underlined extremely low residual levels, generally well below the legal limits. Therefore, also the conventional productive trials, have guaranteed the product from the hygienic-sanitary point of view.

In conclusion, it can be hypothesized that the agronomic technique employed on the crops in examination doesn't results, in consistent way, on the degree of attack of the pathogens and what it cannot be spoken of greater risk in one of the two methods of production in comparison.

If a difference doesn't exist, in terms of hygienic-sanitary quality of the product the importance of the smaller correlated environmental impact must not be neglected and brings to prefer this agricultural method of production in line with the increasing sensibility for the respect of the environment and the greatest social responsibility of the consumers.

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